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ABSTRACT

This student workbook is designed to assist advanced medical-surgical nursing students in understanding and making electrocardiographic (EKG) interpretations. Addressed in the seven units of the workbook are the following topics: EKG indicators, EKG ruled paper divisions, the normal cardiac cycle and pathophysiology, abnormal cardiac waves, atrial and ventricular rhythmycity, EKG heart rate determinations, and analysis of EKG strips. Each unit contains a set of specific learner-related objectives, related learning assignments, review questions or exercises, new terminology, and an introduction to the specific EKG concept covered in the unit. (MN)

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"EKG STUDENT WORKBOOK"

Sandra M. Webb

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INTRODUCTION

The EKG Student Workbook was developed especially for advanced medical-surgical nursing students.

The workbook was designed to help facilitate students' understanding of EKG interpretations and provide practice exercises to help in the application of this newly learned skill.

The workbook is also intended to prepare student nurses for classroom instructions related to EKG interpretation. Consequently, it is recommended that the student perform all of the exercises in the workbook prior to classroom instructions. It is further recommended that the student jots down any questions that he/she may have that is related to the exercises so that these questions can be addressed during the lecture presentation.

ORGANIZATION OF THE WORKBOOK

This workbook is divided into seven sections; each section having a set of specific learner-related objectives, related learning assignments, review questions or exercises, new terminology and introduction to the specific EKG concept.

- The introduction to the concept provides the student with a synopsis of the content that is needed to perform the review exercises or answers the review questions.
- The related learning assignment-informs the student of the specific independent activities that he/she should perform to help reinforce the information provided in the introduction to the concept.
- The learner objectives reflect the learner outcomes for the section.
- The terminology column lists all of the newly introduced EKG terminology and/or abbreviations that the student should become familiar with.
- The review qeustions or practice exercises are designed to help students understand the rationale and/or apply the newly introduced skills addressed in the introduction of the concept.

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SECTION I

"EKG INDICATIONS"

Introduction to the Concept

The electrocardiogram (E.C.G. or E.K.G.) is a graphic representation of the electrical activity of the heart and its ability to pump blood throughout the body. The E.K.G. therefore supplies the clinician with valuable information about the hearts' conduction abilities. Additionally, the information gained from the interpretation of the EKG strip takes on more meaning when it is used in conjunction with other clinical parameters (for example, blood pressure, pulse rate and diagnostic lab values).

Behavioral Objectives

1. The student will list the indications for an EKG.
2. The student will write the rationale for performing an EKG.

Related Learning Assignment

Read: Brunner and Suddarth, V Edition, Pg. 560.

Huang, Dasher, Larson and McCoulloch. Coronary Care Nursing, Pg. 28-29.

View: Videotape "EKG Monitoring".

Review Questions

1. What are the four major classifications for performing and EKG?

2. Why is an EKG indicated in myocardial infarction (MI).

3. Why is an EKG indicated in congested heart failure (C.H.F.).

4. What is reason(s) for performing an E.K.G. on a client with complaints of irregular heart beats?

5. What is/are the reason(s) for performing an E.K.G. on clients who are prescribed digoxin, quinidine and/or inderal?

Practice Exercise

DIRECTIONS: Match the classification for EKG indications with the condition or clinical parameter.

Condition/Parameter	Classification
M. I.	Cardiac
C. H. F.	Inflammatory
Pneumonia	Metabolic
Respiratory Acidosis	Pharmaceutical
Catecholamine	
Anesthetic	
Hypokalemia	
Hypocalcemia	

Terminology

DIRECTION: Define each of the words listed below

Infarction

Injury

Ischemia

Hypertrophy

SECTION II

"THE EKG PAPER"

Introduction to the Concept

The clinician must first understand the ruled divisions on the EKG paper before an interpretation of the clients EKG can be accurately made.

The E.K.G. strip is divided into large squares and small squares, each having a horizontal and vertical axis. The horizontal axis denotes the duration of the cardiac event. While the vertical axis denotes the voltage of the cardiac event.

Large Squares

Each of the large squares are 5 millimeters (mm) in height (vertical axis) and in width (horizontal axis). The 5 mm vertical axis represents (0.5) millivolts (mv) of electrical energy or voltage. While the 5 mm horizontal axis reflects 0.20 seconds in time duration.

Small Squares

The small squares in comparison to the large squares are only 1 mm in height and width. Consequently the 1 mm vertical axis reflects 1 mv of electrical energy (voltage). While the 1mm horizontal axis is equal to 0.04 seconds in duration.

Sample EKG Paper

Large Square

Small Square

Behavioral Objectives

The student will make accurate determinations of EKG time, duration and voltage.

Related Learning Assignment

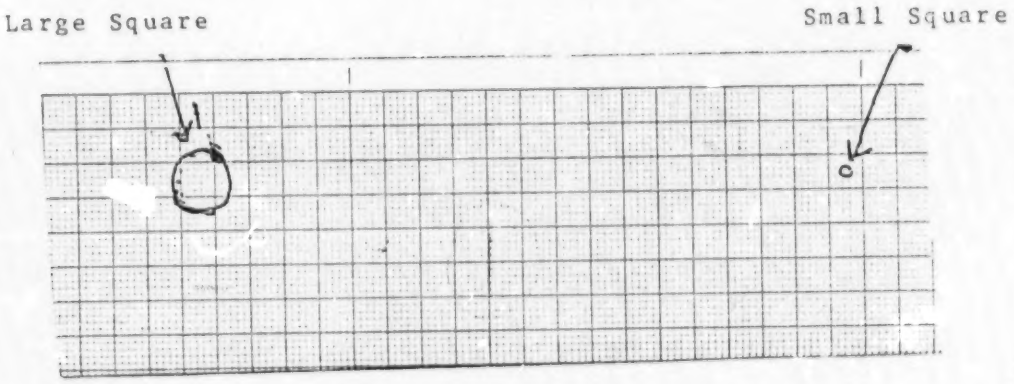
Read: Brunner and Suddarth, Pg. 564-565.

Huang, et. al., Pg. 29-30.

Small Squares

The small squares in comparison to the large squares are only 1 mm in height and width. Consequently the 1 mm vertical axis reflects 1 mv of electrical energy (voltage). While the 1mm. horizontal axis is equal to 0.04 seconds in duration.

Sample EKG Paper



Behavioral Objectives

The student will make accurate determinations of EKG time, duration and voltage.

Related Learning Assignment

Read: Brunner and Suddarth, Pg. 564-565.

Huang, et. al., Pg. 29-30.

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Practice Exercise

Look at the sample strip of EKG paper. The uppermost (superior) border or margin of the EKG paper has a black vertical line between every 15 large squares. If the large square represents 0.20 seconds (secs.) then the distance between two of the black vertical lines in the margin represents what length of time?

Look at the line drawn in the center of the EKG strip that is encircled. This line is equal to what amount of electrical energy?

Terminology

DIRECTIONS: Define the terms written below.

Millimeter

Millivolt

Voltage

SECTION III

"THE NORMAL CARDIAC CYCLE AND IT'S PATHOPHYSIOLOGY"

Introduction to the Concept

The normal cardiac cycle is composed of a: P wave, P-R interval, QRS wave complex, Q-T interval, S-T segmant and T wave.

P Wave

The "P wave" is the first wave in the cardiac cycle. It is described as being round and upright and usually looks like this (∩). The normal "P wave" is 0.3 mm in height or 0.3 mv in voltage; the normal time duration associated with the "P wave" is 0.05 to 0.12 secs. This wave denotes atrial depolarization of the heart.

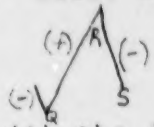
P-R Interval

The "P-R interval" is the second component of the cardiac cycle. It begins with the "P wave" and concludes with the first

deflection be it negative or positive. In otherwords the P-R interval may conclude with the Q wave (first negative (-) deflection) or the R wave (first positive (+) deflection). The P-R interval" reflects the movement of the electrical impulse from the atrias to the A-V node.

QRS Wave Complex

The QRS wave complex is actually a series of deflections within the cardiac cycle. To be matter-of-fact, this complex represents the only series of deflections within the cardiac cycle. It is characterized by the following: the "Q wave" is the first (-) deflection that lasts approximately .04 secs. in duration and its' height or vertical axis is normally less than 1/3 of the total QRS complex (which should be < 5 mm); the "R wave" is the first (+) deflection in the cycle, and is usually greater than 5 mm in height; and the "S wave" is the second (-) deflection in the cycle and it is usually less than 5 mm in size just like the "Q wave". The entire "QRS wave complex" lasts approximtely 0.11 secs. in duration and it looks like this



It is associated with the depolarization of the ventricles within the heart.

Q-T Interval

The "Q-T interval" represents the time period from the beginning of the "Q wave" until the end of the "T wave". The normal range for this time period is approximately 0.32 secs. to 0.43 seconds. It is associted with ventricular systole and the calcium (Ca++) electrolyte.

S-T Segment

The "S-T segment" refers to that section of the EKG baseline that is between the "QRS wave complex" and the "T wave". This segment is usually flat or equal to the EKG baseline.

Behavioral Objectives

1. The student will identify every wave, interval and segment in the cardiac cycle.
2. Students will calculate the voltage and duration for every wave in the cardiac cycle.

Related Learning Assignment

Read: Brunner and Suddarth, Pg. 565-567.

Huang, et. al., Pg. 28-33.

View: Videotape "Ekg Interpretation"

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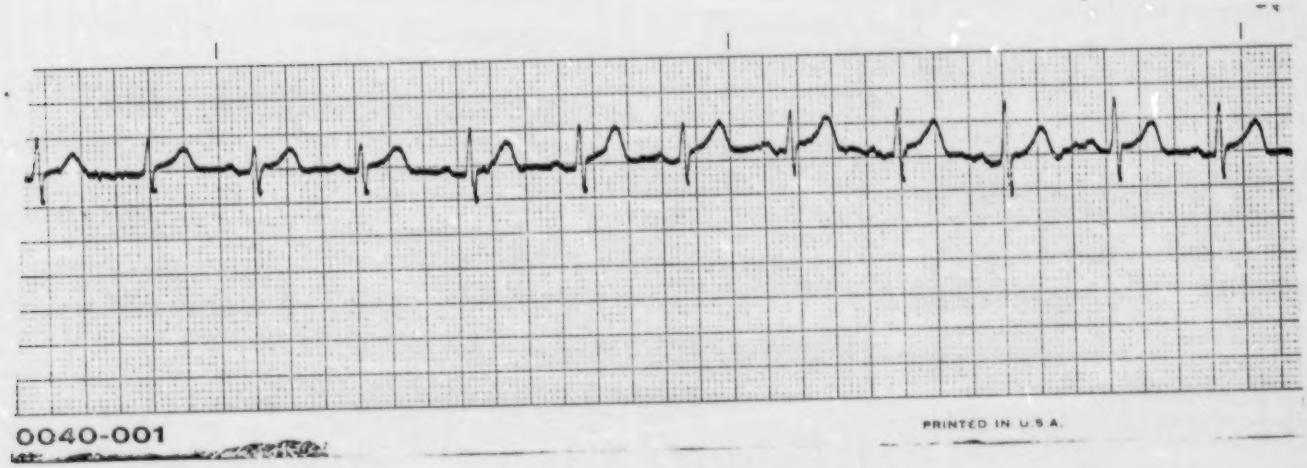
Practice Exercise

(Utilize the EKG strip below in carrying out the following directions.)

DIRECTIONS:

1. Circle each of the waves, intervals and segments; 2. Calculate the voltage for the Q wave, R wave and S wave; and 3. Calculate the duration of the P wave and QRS wave complex.



Terminology

Define the listed terminology.

Segment	Deflection
Interval	Systole
Wave	Repolarization
Complex	Depolarization

Practice Exercise

(Utilize the EKG strip below in carrying out the following directions.)

DIRECTIONS:

1. Circle each of the waves, intervals and segments; 2. Calculate the voltage for the Q wave, R wave and S wave; and 3. Calculate the duration of the P wave and QRS wave complex.

Terminology

Define the listed terminology.

Segment	Deflection
Interval	Systole
Wave	Repolarization
Complex	Depolarization

SECTION IV

ABNORMAL WAVES

Introduction to the Concept

Abnormal cardiac waves, segments and/or intervals indicate alterations in the transmission of the electrical impuse of the heart. This suggests abnormal cardiac physiology.

Atrial Abnormality

An abnormal or inverted "P wave" signals an impairment in the conduction of the electrial impulse to the atria. This wave looks like this (⌐).

Ventricular Abnormality

A widened and distorted "QRS complex" that is > 0.11 secs. in duration and or a large spiked Q wave that is approximately one-third of the total voltage (height) of the QRS complex indicates abnormal ventricular depolarization.

An inverted "T" wave also signals impaired ventricular activity specifically, ventricular repolarization. An elevation

or depression of the "S-T segment" above or below the baseline further indicates ventricular injury. An elevation above the baseline specifically indicates acute ventricular injury; while a depression of the "S-T segment" below the baseline signals infarction or coronary ischemia.

It is important to know that a prolonged or shortened "Q-T interval" indicates a calcium (Ca++) electrolyte imbalance. While a wave that looks like a "u" and appears after the "T wave" signals a potassium (K+) deficient.

Behavioral Objectives

The student will identify the abnormal wave and explain its related pathophysiology.

Related Learning Assignment

Read: Brunner and Suddarth, Pg. 569-572.

Huang, et. al., Pg. 28-33.

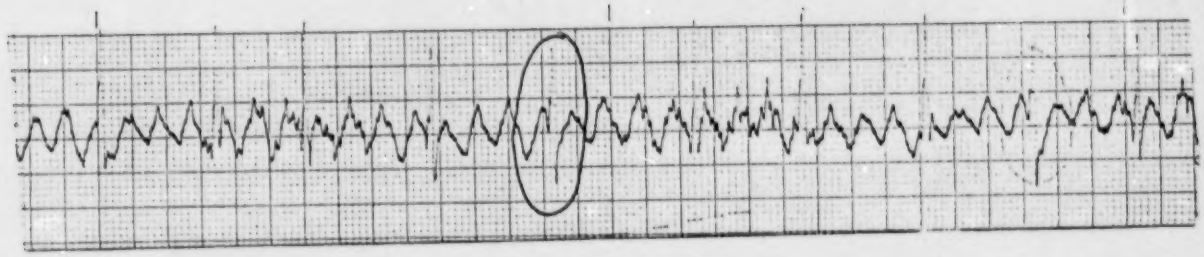
Practice Exercise

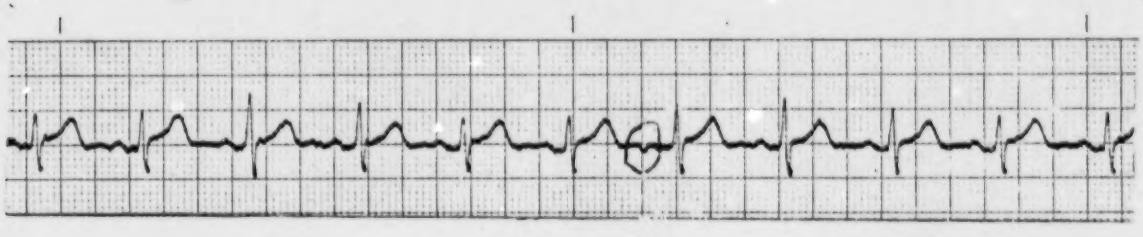
1. Identify the abnormal encircled waves in the two EKG strips below.
2. Explain the pathophysiology associated with each of these abnormal waves.

Terminology

Define the term listed below.

Baseline





Practice Exercise

1. Identify the abnormal encircled waves in the two EKG strips below.
2. Explain the pathophysiology associated with each of these abnormal waves.

Terminology

Define the term listed below.

Baseline

SECTION V

ATRIAL AND VENTRICULAR RHYTHMICITY

The regularity of the contractions by the atrias and ventricles can be determined using two techniques.

The first technique involves the use of an index card, preferably a plain unlined index card. While the second method involves the use of a caliper. This last method will be discussed in class. We will only discuss the index method for now.

Index Technique

Using the sample EKG strip below take one index card and place it slightly beneath the baseline of the sample EKG strip. Now slide the index card from the baseline of the cardiac cycle up to the tips of the "R" waves. Draw a vertical line, on the index card, at the tip of the first "R" wave and another vertical line, on the index card, in at the tip of the second "R" wave (R-R). Using these two vertical lines measure the distance between each "R" wave on the entire EKG strip.

If the distance remains the same for each "R-R" wave assessment then the ventricular contraction is considered "regular." However, if the distance between the "R-R" measurements are variable then the ventricular contractions are deemed "irregular." All "Irregular" contractions (variable R-R measurements) must be reported immediately because they require further evaluation.

The atrial contraction can be assessed by applying the same procedure to the "P" waves, using another index card.

Behavioral Objective

1. The student will determine the ventricular rhythmicity.
2. The student will determine the atrial rhythmicity.

Related Learning Assignment

See Practice Exercise.

Practice Exercise

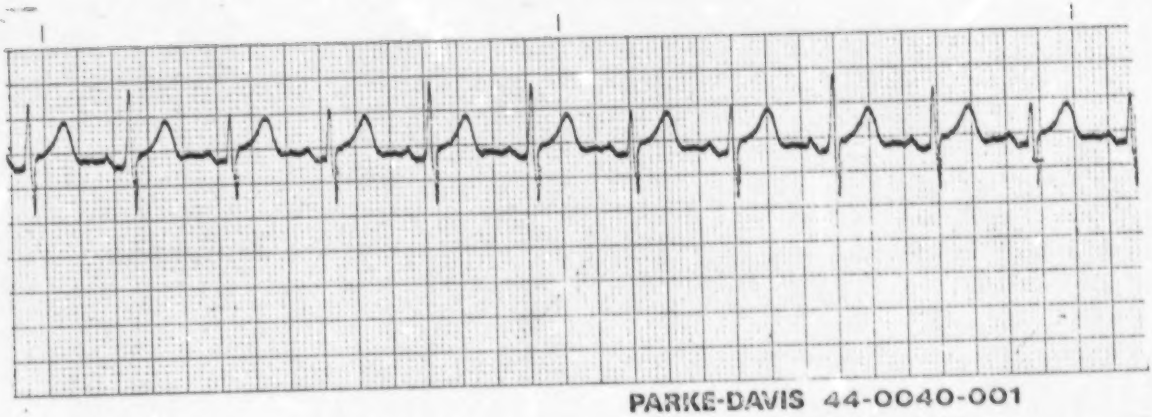
Using the EKG strip below:

1. Determine the rhthymicity of the "R" waves.
2. Determine the rhthymicity of the "p" waves.

Terminology

Define the following term.

Caliper



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Practice Exercise

Using the EKG strip below:

1. Determine the rhthymicity of the "R" waves.
2. Determine the rhthymicity of the "P" waves.

Terminology

Define the following term.

Caliper

SECTION VI

HEART RATE DETERMINATIONS

Pulse rate determinations can also be made from the EKG strip. Three methods can be utilized for these determinations, i.e., "rule of triplicate", "R" waves, and "P" waves.

Rule of Triplicates

300	150	100	75	60	50	43	37	33
1	2	3	4	5	6	7	8	9

(Figure 1)

This rule pertains to the distance between "R" waves. Simply put, it measures the large square divisions between each "R-R" and divides this number into 300. The resulting quotient (answer) is equal to the clients' heart rate. Thus, if there is only one large square division between "R" waves the heart rate is 300 ($1 \div 300 = 300$); two large square divisions the rate is 150 ($2 \div 300 = 150$) and so on. Refer to Figure 1 for this schematic representations.

"R" Wave

The clinican using the "R" wave methodology must always have a six second EKG strip (30 large squares). He/she must then count the "R" waves occurring within this six second interval of time and multiply by 10 (6 secs. X 10 = 60 secs. = 1 minute). The resultant answer is equal to the clients' pulse per minute.

"P" Waves

This method requires counting all of the small square divisions between two "P" waves (P-P) and dividing by 1500. This value reflects the atrial pulse rate. The previous methods reflect the ventricular pulse rate.

Another "R" wave technique for calculating heart rate can be done using the "P" wave method described above. Utilization of this method simply entails substituting "R" waves' each time "P" waves' are mentioned and dividing by 1500.

Behavioral Objective

The student will determine heart rate per minute using the rules of triplicate, "R" wave methods and "P" wave method.

Related Learning Assignment

Read: Huang, et. al., Pgs. 43-44.

Practice Exercise

The student will calculate the heart rates per minute using the EKG strip below, applying each of the following techniques:

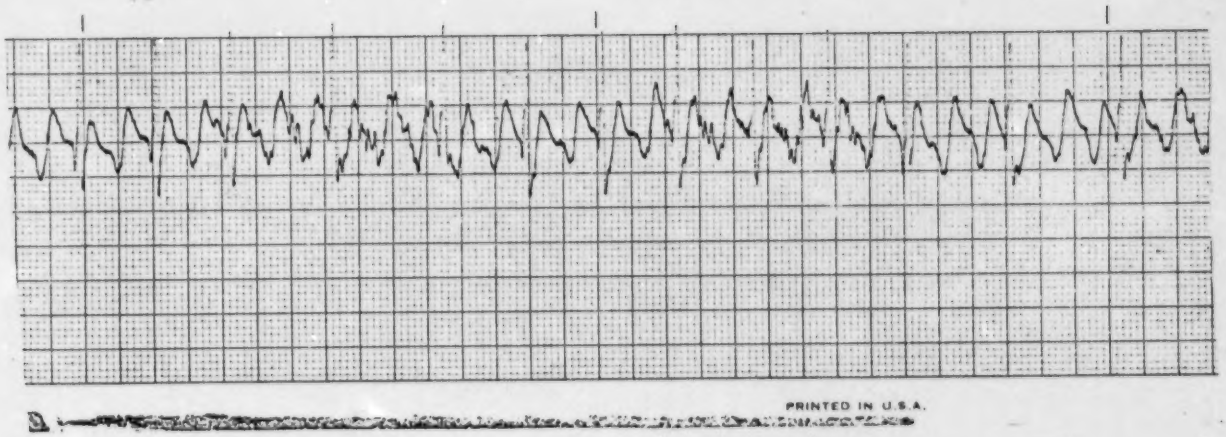
- A. "Rules of Triplicates"
- B. "R" Wave Method
- C. "P" Wave Method

Terminology

Define the following:

Ventricular Pulse Rate

Atrial Pulse Rate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SECTION VII

CONCLUSION

Wow! Believe it or not, you have just learned all of the skills needed for basic EKG determinations. All that's left to be done now is PRACTICE. After all practice makes perfect!!! So lets' go back to Section V and interpret all of the EKG strips up to Section VII for rate, rhythm, wave formation, interval, segment and duration.

Have fun with your newly learned skill and remember the seriousness of it's implications.